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United States Department of Agriculture,

OFFICE OF EXPERIMENT STATIONS.

REPORT OF COMMITTEE ON METHODS OF TEACHING AGRICULTURE.[1]

NEED OF UNIFORMITY IN THE STUDY OF AGRICULTURE.

The committee on methods of teaching agriculture submit a report of progress. From the outset of its work the committee has recognized the fact that a thorough investigation of the subject entrusted to it would require a long time. It has therefore endeavored during the past year simply to lay the foundation for future work. The first thing was to find out what was done in this country in the teaching of agriculture. A circular of inquiry sent out for the committee by the Office of Experiment Stations has elicited responses from about 50 colleges. These replies, grouped under 13 general heads, have been tabulated and brief summaries have been prepared which will be submitted as a part of this report. A large amount of data has been collated in this way which will be useful in further studies in this line.

The general conclusion thus far drawn from an examination of the data, though a negative one, is well worthy of the serious consideration of the association. It is plainly shown that there exists at present in this country no standard for instruction in agriculture. There is a bewildering variety as regards the topics taught, the time devoted to each topic, the order in which the different topics occur in the course, the relative amounts of class-room work and laboratory or practical exercises, etc. Granting all that ought to be conceded because of local conditions, it is nevertheless obvious that general progress in the teaching of agriculture in college courses can hardly be expected until there is greater uniformity in planning and conducting the course of study in this subject. Toward securing reasonable uniformity in this matter it behooves this association, as well as the individual teachers of agriculture, to give earnest heed.

The committee is not prepared at this time to go much beyond this simple declaration of the great need of studying this subject thoroughly and deeply. More time must be spent in digesting the data collected and in discussing the evidence adduced before detailed conclusions can be drawn. On one point, however, the committee wishes to present to the association some further considerations.

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[1] This report, with accompanying papers, was presented to the Association of American Agricultural Colleges and Experiment Stations at the convention held in Washington, D. C., November 10-12, 1896.

NECESSITY OF DEFINITE NOMENCLATURE.

One great obstacle to the intelligent discussion of the scheme of agricultural instruction and the methods of agricultural teaching is the lack of a definite nomenclature of the subject. This confusion of terms is evident in the data collected by the committee, as well as in much of the current discussion of this subject which appears in the public prints. It is obviously not an easy matter to bring order out of confusion in such a case. The committee has not been able to give time enough to this phase of the subject to definitely settle anything even in the minds of its own members. It proposes, however, to suggest for the consideration of the association a tentative scheme for the division of what is commonly designated agriculture in courses of study into several distinct branches or subdivisions, and for giving each of these branches a definite name, as follows:

Agriculture	1. Agronomy, or agriculture (technical).	Climate, soils, fertilizers, and crops—plant production.
	2. Zootechny, or animal industry.	Animal physiology and animal production.
	3. Agrotechny, or agricultural technology.	Agricultural industries, e. g., dairying, sugar making.
	4. Rural engineering, farm mechanics, or farm equipment.	Roads, drains, irrigation systems, farm buildings, etc.
	5. Rural economy, or farm management.	General policy of farm management, rural law, agricultural bookkeeping, etc.

If we can reach a point where the term *agriculture*, as applied to what is taught on agricultural subjects in a college course, shall generally be understood to include at its widest the five subordinate subjects indicated in the above scheme, and in its restricted sense only what applies to plant production, an important step will have been taken in settling the proper boundaries of agricultural instruction and in fixing the proper subdivisions of the general subject. It is probable that the substitution of a more definite and technical term for agriculture in its restricted sense would simplify matters. The term agronomy is tentatively suggested as such a term, and the opinion of members of the association on this, as well as on the other terms suggested, is invited.

COURSES IN AGRICULTURE IN FOREIGN SCHOOLS.

Before presenting the summary of data collected by the committee it may be well to add that examination of the courses in agriculture in foreign schools was made as far as practicable. One member of the committee had the privilege of visiting representative agricultural schools in Germany, France, Belgium, and Holland during the past summer, and holding personal conferences with leading agricultural educators in these countries. The general results of his observations will be given in a brief paper appended to this report. At the suggestion of the Director of the Office of Experiment Stations, Prof. F. W. Woll, of Wisconsin, made a special investigation of agricultural institutions in Denmark, Norway, and Sweden during a vacation trip last summer. A brief statement of the results of his observations is also appended to this report, and it is hoped that he will present a longer account in the Experiment Station Record.

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Committee.

November 10, 1896.

SUMMARY OF DATA ON SOME POINTS IN CIRCULAR OF INQUIRY SENT BY COMMITTEE TO AGRICULTURAL COLLEGES.

SOILS AND SOIL PHYSICS.

This subject is taught under the following names: Soils, soils and crops, general agriculture, principles of agriculture, agricultural chemistry, etc. In 34 colleges the total time given to this subject varies from 10 to 280 and averages 70 hours; the time given to lectures or recitations varies from 8 to 75 and averages 37 hours; the time given to field or laboratory work varies from 0 to 269 hours.

Twelve colleges teach this subject in freshman year, 11 in sophomore year, 12 in junior year, and 5 in senior year. In 30 colleges this subject is taught by the professor of agriculture or his assistant, in 8 by the professor of chemistry, in 5 by the professor of physics, in 1 by the professor of biology.

FARM MANURES AND COMMERCIAL FERTILIZERS.

This subject is taught under the following names: Agriculture, agricultural chemistry, manures and fertilizers, soils and chemistry of plant growth, application of chemistry to agriculture, etc. In 30 colleges the time given to this subject varies from 5 to 228 minor or 418 major, and averages 61 hours; the time given to lectures or recitations varies from 5 to 85 and averages 40 hours; the time given to field or laboratory work varies from 4 to 190 hours.

Nine colleges teach this subject in freshman year, 10 in sophomore year, 11 in junior year, and 6 in senior year.

In 25 colleges this subject is taught by the professor of agriculture or his assistant, in 9 by the professor of chemistry, in 1 by the professor of physics.

FARM CROPS.

This subject is taught under the following names: Agriculture, agricultural chemistry, farm crops, soils and crops, grasses and grains, grasses and forage plants, field crops, general farm management, etc.

In 28 colleges the time given to this subject varies from 10 to 315 and averages 81 hours; the time given to lectures or recitations varies from 8 to 200 and averages 39 hours; the time given to field or laboratory work varies from 0 to 250 hours.

Ten colleges teach this subject in freshman year, 10 in sophomore year, 11 in junior year, and 6 in senior year.

In 31 colleges this subject is taught by the professor of agriculture or his assistant, in 1 by the professor of chemistry, in 1 by the professor of physics, in 1 by the professor of biology.

BREEDS OF LIVE STOCK.

This subject is taught under the following names: Agriculture, breeds of live stock, apiculture, stock breeding, study of breeds, animal husbandry, stock judging, etc.

In 32 colleges the time given to this subject varies from 10 to 180 minor or 360 major, and averages 76 hours; the time given to lectures or recitations varies from 6 to 90 and averages 39 hours; the time given to field or laboratory work varies from 0 to 90 hours minor or 270 major.

Eleven colleges teach this subject in freshman year, 8 in sophomore year, 16 in junior year, and 2 in senior year.

In 28 colleges this subject is taught by the professor of agriculture or his assistant, in 1 by the professor of biology, in 7 by the professor of animal husbandry.

ANIMAL EXTERIOR OR STOCK JUDGING.

This subject is taught under the following names: Agriculture, stock breeding, domestic animals, stock judging, animal husbandry, breeds and breeding, general agriculture, principles of breeding, animal mechanism and exterior, breeds of stock, etc.

In 15 colleges this subject is taught in connection with breeds of live stock, and in 1 with dairying; in 12 others the time given to it varies from 5 to 70 and averages 29 hours; the time given to lectures and recitations varies from 4 to 42 and averages 15 hours; the time given to field or laboratory work varies from 0 to 60 hours.

Three colleges teach this subject in freshman year, 3 in sophomore year, 7 in junior year, and 2 in senior year.

The professor of agriculture or his assistant gives instruction on this subject in each college reporting.

PRINCIPLES OF BREEDING.

This subject is taught under the following names: Agriculture, stock breeding, breeding farm animals, principles of heredity, breeding, feeding, dairying, animal husbandry, breeds and breeding, animal industry, etc.

In 30 colleges the time given to this subject varies from 8 to 210 and averages 51 hours; the time given to lectures or recitations varies from 8 to 70 and averages 34 hours; the time given to field or laboratory work varies from 0 to 140 hours.

In 1 college this subject is taught in freshman year, in 8 in sophomore year, in 13 in junior year, and in 10 in senior year.

In 25 colleges this subject is taught by the professor of agriculture or his assistant, in 5 by the professor of animal husbandry.

STOCK FEEDING.

This subject is taught under the following names: Agriculture, stock feeding, breeding, feeding, dairying, animal husbandry, breeds and breeding, agricultural chemistry, analyses of forage plants, principles of animal nutrition, chemistry of foods; feeding for butter, beef, and milk; foods and nutrition, feeds and feeding, etc.

In 32 colleges the time given to this subject varies from 15 to 185 minor or 370 major, and averages 84 hours; the time given to lectures or recitations varies from 12 to 80 and averages 40 hours; the time given to practical or laboratory work varies from 0 to 125 hours minor or 310 major.

In 2 colleges this subject is taught in freshman year, in 5 in sophomore year, in 14 in junior year, and in 15 in senior year.

In 29 colleges this subject is taught by the professor of agriculture or his assistant, in 3 by the professor of chemistry, in 4 by the professor of animal husbandry, in 1 by the professor of veterinary science.

BUTTER MAKING.

This subject is taught under the following names: Dairying, general and agricultural chemistry, home dairying, farm dairying, the dairy, butter making, dairy husbandry, etc.

In 27 colleges the time given to this subject varies from 6 to 784 and averages 104 hours; the time given to lectures or recitations varies from 6 to 110 hours; the time given to practical or laboratory work varies from 10 to 620 hours.

In 3 colleges this subject is taught in freshman year, in 7 in sophomore year, in 10 in junior year, and in 10 in senior year.

In 15 colleges this subject is taught by the professor of agriculture, or his assistant, in 4 by the professor of chemistry, in 2 by the professor of animal husbandry, in 10 by the professor of dairying, in 1 by the professor of household economy.

CHEESE MAKING.

This subject is taught under the following names: Cheese making, dairying, dairy husbandry, Cheddar cheese making, etc.

In 6 colleges the time given to this subject varies from 4 to 550 and averages 207 hours; the time given to lectures and recitations varies from 4 to 36 and averages 22 hours; the time given to laboratory or practical work varies from 0 to 300 hours.

Six colleges teach this subject in the junior year, 2 in the senior year.

In 2 colleges this subject is taught by the professor of chemistry, in 4 by the professor of dairying or his assistants, and in 2 by the professor of agriculture or his assistant.

FARM ENGINEERING OR EQUIPMENT.

This subject is taught under the following names: Agriculture, farm machinery, highways and pavements, engineering, farm equipment, agricultural engineering, irrigation engineering, farm mechanics, etc.

In 20 colleges the time given to this subject varies from 10 to 240 and averages 75 hours; the time given to lectures and recitations varies from 10 to 72 and averages 40 hours; the time given to practical or laboratory work varies from 10 to 72 hours.

Four colleges teach this subject in the freshman year, 7 in the sophomore year, 5 in the junior year, and 7 in the senior year.

In 17 colleges this subject is taught by the professor of agriculture or his assistant, in 1 by the professor of civil engineering, in 1 by the professor of animal industry, in 3 by the professor of mathematics, in 2 by the professor of physics.

RURAL ECONOMICS OR FARM MANAGEMENT.

This subject is taught under the following names: Agriculture, farm management, farm economy, political economy, farm accounts, rural economics, farm relations and management, etc.

In 11 colleges the time given to this subject varies from 10 to 140 and averages 49 hours; the time given to lectures varies from 10 to 140 and averages 38 hours; the time given to practical or laboratory work varies from 0 to 60 hours.

Two colleges teach this subject in the freshman year, 3 in the sophomore year, 5 in the junior year, and 5 in the senior year.

In 14 colleges this subject is taught by the professor of agriculture, in 1 by the professor of horticulture, in 1 by the professor of chemistry.

HISTORY OF AGRICULTURE.

In a number of the colleges this subject is not taught at all, and in others in connection with other subjects. It is taught under history of agriculture in 6 colleges, where the time given to it varies from 10 to 55 and averages 27 hours.

Two colleges teach this subject in the freshman year, 3 in the sophomore year, 1 in the junior year, and 2 in the senior year.

In 13 colleges this subject is taught by the professor of agriculture or his assistant, in 2 by the professor of chemistry.

MISCELLANEOUS.

The following subjects are by different colleges considered a part of the course in agriculture:

Viticulture,
Olive culture,
Pomology,
Horticulture,
Botany,
Bacteriology,
Plant breeding,
Plant diseases,
Forestry,
Entomology,
Veterinary science,
Poultry keeping,
Handling meats,
Sugar making,
Sugar chemistry,
Sugar beets,
Meteorology,
Textile fibers,
Domestic economy,
Physical geography,
Principles of evolution.

SOME FEATURES OF EUROPEAN INSTITUTIONS FOR AGRICULTURAL EDUCATION.

By A. C. TRUE, Ph. D.,
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AGRICULTURAL EDUCATION IN EUROPE.

The system of agricultural education in Europe is much more complex than our own. It includes schools of different grades, ranging from those for quite elementary education in connection with the public-school system up to those of university grade. If we undertake to consider schools of any particular grade in this series, we shall find that their organization and courses vary with the locality, so that it would be hardly fair to select any one institution as typical. In a general way, however, we may classify European institutions for agricultural education as follows: (1) Departments of universities; (2) institutes for higher education in agriculture, more or less closely affiliated with universities; (3) institutes organized as separate institutions; (4) schools of secondary grade under governmental control; (5) schools of secondary grade managed by private individuals or corporations (often religious orders) subsidized by the Government; (6) courses in agriculture of secondary grade in public or private schools for general education; (7) courses in agriculture in normal schools for the training of teachers in primary schools; (8) courses in agriculture in public or private primary schools; (9) evening schools giving elementary instruction in agriculture; (10) short courses of lectures on general agriculture or on special agricultural subjects; and, (11) farmers' meetings, corresponding to our farmers' institutes.

PROMINENCE OF POST-GRADUATE EDUCATION.

In the European scheme of agricultural education a relatively large place has been given to the higher or post-graduate education in agricultural science. Numerous opportunities are afforded for the most thorough and scientific training in the different branches of this complex science. The result is that there is an ever-increasing body of well-trained investigators and teachers whose services can be utilized at the experiment stations, agricultural schools, agricultural departments of the Governments, or in those agricultural industries requiring scientific knowledge of a high order. The value of such workers to agricultural research and education can hardly be overestimated. Until we are able to secure such thoroughness of training for our investigators and teachers we must expect a certain structural weakness to pervade our whole system of agricultural research and education. It is true that some of our workers in these lines get a part of their training in the foreign schools. This is far better than that they should not have it at all, yet some of us can not help but feel that along with much that is very good from every point of view they are apt to acquire a foreign trend of thought which ofttimes hinders their highest success in this country. And, surely, we will not be content until the United States affords in agriculture, and every other branch of learning, at least as good opportunities for the highest education as can be found anywhere in the world.

SPECIAL COURSES IN EUROPEAN INSTITUTIONS.

Another element of the European plan of education in agriculture, as in other subjects, is what may be called freedom to obtain what the capabilities, inclinations, or necessities of the student require. In connection with institutions for superior or secondary education in agriculture, provision is made for special students who are relieved from entrance examinations and may either follow the general course or pursue selected topics as may be agreed upon with the managing body of the institution. This is in accordance with the general plan followed in Europe with respect to higher education. Thousands of students, who have no intention of taking a degree, are thus pursuing special courses in the universities and higher schools. This privilege is undoubtedly abused to a considerable extent, but is believed to raise the general level of intelligence in the community and secure for the higher schools a large number of influential constituents. It might well be doubted whether any such plan could be followed in American colleges and universities under present conditions. It is probable, however, that we have hitherto erred in insisting too rigidly on definite requirements for all or nearly all the students admitted to our higher institutions. The result of this plan has been that many institutions have felt obliged to keep the requirements for a degree at too low a grade, and they have probably excluded altogether a considerable number of students who might have profited more or less by their instruction. There is, of course, in this country a great lack of good secondary schools, and our colleges are therefore required to give their students routine instruction with a view to fixing their habits of study. In this way in many of our institutions two years are mainly occupied in work which would properly be done in secondary schools. This makes it necessary for the college to be more rigid in its courses of study and to have codes of regulations which must apply to all students alike without due reference to their age and acquirements or the purpose for which they come to the college. It is to be hoped that in the near future many of our colleges will be able to raise the standard of their courses leading to degrees without at the same time depriving students who desire to pursue special courses of the privileges which they might properly enjoy in these institutions.

ELEMENTARY INSTRUCTION IN FRANCE AND BELGIUM.

As regards elementary instruction in agriculture to children in the ordinary schools, France and Belgium are the countries which have undertaken this kind of work on the most systematic plan. The following example may serve to illustrate the character of this work under quite favorable conditions:

During the past summer the writer visited a primary school in Belgium which is fortunate in possessing a well-equipped teacher, thoroughly interested in agricultural instruction. This school is located at a small village in one of the most populous districts of Belgium. At the time of the visit the teacher gave a lesson on the properties and uses of milk to a class of boys and girls about 12 years old. Samples of milk and cream were brought into the presence of the pupils, together with other illustrative material relating to the composition and uses of milk. By means of elementary chemical experiments and skillful questioning, the teacher gave to the pupils a simple but clear explanation of such matters relating to the composition and uses of milk as they could reasonably be expected to understand at that early age. The summing up of the lesson by different members of the class showed that they had been well taught, and there is no doubt that from that time forth the horizon of their knowledge regarding milk was considerably wider than if the lesson had not been given. The teacher of this class was a man, as it is not customary to employ women in the public schools in Belgium. He had evidently made good use of the very limited means at his disposal for providing illustrative material for his classes. The walls of the schoolroom were hung with charts, on many of which were pictures of agricultural implements, different varieties of plants, etc., which had been cut from advertising posters. Adjoining the school was a small garden, in which a considerable number of different kinds of plants were grown and different methods of culture were tried for the information of the pupils. Close by were the rooms of the agricultural society of the village, which contained collections of seeds, grains, etc., as well as charts giving the composition of fertilizers, results of experiments, and other things which would be of interest in connection with the discussions of the society, and which were doubtless available for use in the school. The teacher of the school acted as secretary of the society, aiding the farmers in the purchase of fertilizers and in other ways. Rooms were being fitted up for a cooperative dairy for the benefit of the villagers, which was to be supplied with the most improved appliances for the creamery business. It seems quite clear that children trained in a school under such circumstances would have a much broader outlook regarding agricultural affairs and be much more inclined to avail themselves of the results of advanced experience and experimentation in agriculture than their fathers had been.

It must be said, however, that this work is still regarded as in an experimental stage. The chief things lacking to make it thoroughly successful are good teachers and suitable text-books. In Germany this lack has been largely instrumental in preventing the undertaking of systematic instruction in these schools. There have been some attempts in this direction, but they have been voluntary on the part of the teachers. Recently a beginning has been made in Germany of providing instruction in agriculture in the normal schools. Such teaching in the normal schools of France and Belgium is pursued with more system and the number of teachers who are equipped to give elementary instruction in agriculture is increasing. In Germany elementary instruction in agriculture for adults is provided by what are called "winter schools," which are held for five or six months during the period from October to May. These are said to be quite successful and are increasing in number. During the summer season the teachers of these winter schools are occupied in lecturing and other work for the agricultural societies. Short courses of lectures in general agriculture or on special agricultural subjects, and farmers' meetings of one or two days' duration, corresponding somewhat to our farmers' institutes, are provided in several countries and are quite largely relied upon for disseminating the results of investigations in agriculture at the experiment stations and kindred institutions. To a considerable extent these take the place of the experiment station bulletins. There is a strong feeling in Europe that in order to make agricultural science of use to the ordinary farmer there must be oral teaching and ocular demonstrations by means of simple experiments or field tests.

SECONDARY SCHOOLS.

The secondary schools in agriculture range from very practical schools, in which a large amount of work is required of the students, to institutions in which the instruction is altogether theoretical and constitutes but a small part of the general curriculum. In the best schools of this grade the tendency is to reduce the amount of practical work required of the students and to treat the farm and garden more and more as an agricultural or horticultural laboratory. These schools are well provided with apparatus, collections of specimens, and other material for illustration and demonstration. The teachers are as a rule men who have received a thorough general and scientific education, and their pedagogic ability and experience are also taken largely into account in filling vacant positions. The method of intuitive or object teaching has been more thoroughly elaborated in Europe than in this country. As a rule, therefore, without doubt, the quality of the teaching done in these schools is relatively high. The practical end to be attained is kept clearly in view in the courses of instruction in these secondary schools. It is expected that their graduates will go into some kind of agricultural industry. They are very likely to become managers of estates or horticultural establishments. The course in agriculture in these schools actually occupies two or three years. In such schools in Germany a six years' course is provided, three years of which are given to general education. The first three years, however, are for those who have not had opportunities for instruction in the gymnasium or realschule. Students who have had proper preliminary training are permitted to take the agricultural course only. As regards the teachers in these schools, the same difficulty is met with that often presents itself in secondary schools in this country. The teachers being thoroughly educated men and interested in scientific work and problems, are likely to raise the grade of their instruction until they entirely shoot over the heads of their students. It requires the services of superintendents and other officers to keep the instruction at its proper level.

INSTITUTIONS FOR HIGHER EDUCATION.

The institutions for higher education in agriculture are, generally speaking, of the university grade, whether organized as departments of universities or as independent agricultural institutes or schools. The presumption is that the student coming to these institutions has finished his secondary education and is prepared to devote himself in a somewhat independent way to advanced work along the special lines of agricultural science. If he is seeking for a degree he will pursue some approved course of study on the university plan for two or three years, at the end of which he will present a thesis and submit to severe examination. For a degree in agriculture he must, as a rule, prove that he is acquainted with the practical operations of the farm. This knowledge he must obtain for himself, however, either by experience in his earlier life or by practice during vacations or at some other time before coming up for his final examinations. In other words, the acquirement of practical knowledge of agriculture is not considered a part of the course of study. The tendency in these higher institutions is more and more toward abstract and scientific education. The effort is to give a man thorough scientific training by the most approved modern methods and to make him an independent worker in agricultural science in the hope that in future he may be able to advance knowledge in this direction by his own efforts. At the same time numerous students are admitted to the lectures and laboratory courses for the purpose of gaining special information which they deem useful to them for any purpose. Only general tests are required of them for admission, and their proficiency in their chosen studies is not examined into. As long as they do not interfere with the work which is going on for the benefit of students seeking degrees, little attention is given to what they do. In conversations this summer with leaders of agricultural education abroad, it was interesting to observe that they laid great stress on the thorough scientific training of the men who are to be future teachers and investigators in agricultural science. They said that their courses for higher education in agriculture were planned with reference to giving training rather than imparting information. It was not so important that the students should learn certain definite things as that they should acquire scientific methods of thought and activity. As regards preparation for university courses in agriculture, there is still division of opinion in Germany as to whether it is better for the student to take his preliminary studies in the gymnasium or in the realschule. (The gymnasium is a classical school, taking boys at 9 or 10 years of age and giving them a nine years' course, largely in Latin, Greek, and mathematics. The realschule substitutes instruction in natural science for the classics.) The older men who now stand at the head of agricultural science and education are inclined to the opinion that the students who have been trained in the gymnasium are the most thoroughly prepared to understand and appreciate the scientific courses given in universities even in lines relating to agriculture. The younger men, however, many of whom have themselves been educated in the realschule, are in favor of these schools. It is argued on behalf of the gymnasium that, while it gives very little attention to the natural sciences, its courses of study in the languages and mathematics have been thoroughly organized on truly scientific principles of pedagogy, and that the teachers in the gymnasium are as a rule more thoroughly equipped for their work. The students coming from these schools have greater intellectual acumen and have learned more thoroughly how to study. While it is true that their powers of observation as regards the outside world have not been exercised as much as they might be, on the whole they have had such a course of mental gymnastics as fits them easily to take up serious work in any line. It is undoubtedly true that much still remains to be done in Europe as well as in this country in systematizing education in natural sciences and technical subjects and reducing it to pedagogical form. As regards agriculture, there is great variety of opinion as to what subjects should be taught, the topics which should be especially considered in a given period, and the ways in which the different portions of the course should be related to each other. Thus far, especially in the higher institutions for agricultural education, it would appear that efforts have been directed mainly toward specialization of work. This may readily be seen by examining the programmes of such institutions. For example, the Royal Agricultural High School or Institute in Berlin has separate instructors in the following subjects: Physics and meteorology, chemistry, vegetable physiology, mineralogy, geology and soils, geodesy, animal production, zoology, plant production, mathematics, political economy, rural economy, agricultural systematic botany, animal physiology, wine making, veterinary science, agricultural engineering, beet-sugar making, farriery, fruit and vegetable culture, animal anatomy, culture technic, entomology, agricultural machines, colonization and tropical agriculture, chemistry of nutrition. What is to be taught under each of these subjects is largely left to the individual instructor. Laboratory work and the use of collections and other illustrative material, including field and garden demonstrations of agricultural subjects, are more and more employed. Eminent teachers and general officers agree that more attention should be given to the consideration of what is properly included in regular courses in technical agriculture. The following off-hand scheme for a four years' course in agriculture was sketched for the writer by one of the most eminent teachers of Europe. The course simply represents his thought on the matter at the time when it was made. According to the European fashion it was divided into semesters or half-year periods.

First year, first and second semesters: Natural sciences on which agricultural science is based, chemistry, botany, and physics.

Second year, first semester: Chemistry, laboratory practicums, agricultural chemistry, and anatomy.

Second year, second semester: Agricultural chemistry and veterinary science.

Third year, first semester: General agriculture, culture of plants, animal production, and diseases of plants.

Third year, second semester: Dairying, special agriculture, special plant culture, and foods and feeding.

Fourth year, first semester: Arboriculture and work in agricultural laboratory.

Fourth year, second semester: Review.

While this course should not be taken as an order of studies carefully worked out, it represents very well a fundamental idea much insisted upon by the leaders in agricultural education in Europe, namely, that a sound basis of general scientific training should be laid before the science of agriculture can be pursued with advantage. You will observe that the first half of the tentative four years' course just outlined is occupied with laying the foundation for the course in technical agriculture. When this foundation is well laid, then quite rapid progress can be made with the instruction in the science of agriculture per se—that complex science which of necessity takes the facts and principles of several other sciences and recombines them into a science which has direct relations with the practical art of agriculture. In many European schools of agriculture it is expected that the scientific basis will be laid before entrance.

LACK OF SYSTEM IN COLLEGES OF AGRICULTURE IN THE UNITED STATES.

It is, perhaps, at this point that our colleges of agriculture have the greatest difficulty. They are at present such mixed schools. They are attempting to inculcate the practical and add to it a little of the scientific. Or if they have a higher aim, they deem it advisable for prudential or other reasons to extend the course in agriculture through the entire four years' curriculum. As our secondary schools as a rule give very little serious attention to the sciences on which agricultural science is based, either the college students in agriculture are led into scientific mazes which they can not follow, or else the time of the professor of agriculture is taken up in the somewhat futile attempt to explain the scientific basis of agricultural problems to students who have little or no conception of the elementary principles of science. If we add to this the expenditure of considerable time of the students in practical exercises, the result is likely to be that the graduate from even a four years' course in agriculture has a badly assorted stock of knowledge of agricultural science and lacks that thorough and systematic grasp of the subject which is necessary to enable him to fully appreciate its significance or to work successfully as an investigator in advancing the science. Granting all that may be said regarding the differences between European conditions in education and our own, is it not likely that we will be obliged to consider more carefully some of those fundamental questions before we can expect much real advancement in thorough agricultural instruction? Our friends across the water will, without doubt, gladly join with us in efforts to elaborate the pedagogical details of agricultural education. They readily confess that they have hitherto not given the attention to this matter which the subject deserves. But they will be loth to acknowledge that there can be any other proper basis for thorough training in the science of agriculture than a systematic training in the principles of the sciences underlying agriculture.

NOTES ON AGRICULTURAL EDUCATION IN THE SCANDINAVIAN COUNTRIES.

By Prof. F. W. Woll,
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SYSTEM OF EDUCATION.

The system of agricultural education in the Scandinavian countries is arranged along two distinctive lines, secondary and higher instruction. The schools providing elementary instruction in agriculture are located in different parts of each country, and are supported partly by the district in which they are located, and partly by the state; in some cases the state contributes one-half or three-fourths to the support of the schools; in other cases less. There are 12 schools of this kind in Norway, 11 in Denmark, 37 in Sweden, and 12 in Finland; in the last country 11 lower agricultural schools more are provided for and will begin operations in the near future.

In this brief sketch it will only be possible to touch upon the more prominent features of the instruction offered in the institutions of the two kinds mentioned. Since there are but few differences, and these of minor importance, between the systems adopted in the different Scandinavian countries and Finland, it may be sufficient here to describe the plan followed in one country.

SECONDARY SCHOOLS, QUALIFICATIONS FOR ADMISSION, STUDIES, ETC.

The secondary agricultural schools of Norway are built upon common-school education, the aim being to impart fundamental knowledge in agricultural branches for future farmers. The course of instruction generally lasts two years, but occasionally one and one-half years. The system of instruction is partly theoretical, partly practical. The theoretical instruction is given during the winter semester only, viz, from October to April, and the practical instruction during the summer months. The different schools only admit a limited number of pupils in each course, generally 24 each, the number decided upon in each case being selected from the list of applicants according to their qualifications.

To be admitted, students must be 18 years of age on entering the school; of late years the average age of applicants has been nearly 20 years. Each must produce a certificate from a doctor that he is strong, without bodily defects, and free from contagious disease; also from his pastor that he has lived an irreproachable life. They must be able to write fairly correct from dictations, must be efficient in plain arithmetic, and have a fair knowledge of geography and the history of their country; they must finally have had practice in ordinary farm work, and must send in their own applications to the director of the school. In filling places at the schools, preference is given to applicants living in the district which in part supports the school, and to oldest sons owning allodial rights, who therefore may be expected to settle as farmers in the district.

The theoretical instruction, which generally occupies three hours a day during the winter semester, covers the following preparatory studies: Composition, applied arithmetic, plain geometry, chemistry, and physics. The following basal studies are taught: Agriculture (including dairying), forestry, horticulture, bookkeeping and accounts. Practical exercises are furthermore given in surveying, farm machinery, map and building design, drainage, forestry, horticulture, blacksmithing, and carpentry work. These latter studies are taught throughout the year, as far as circumstances permit; in the summer months instruction is largely confined to work in the field or the barns, the students taking part in the regular farm work under the direction of the farm superintendent or the teacher of agriculture. The farms at which the schools are held generally belong to the district (county) where they are located, and vary in size from 100 acres to 200 acres, or more. They are well equipped, and stocked with improved farm animals; there is always a dairy herd at the farms, often numbering 50 head of cattle or more.

At the conclusion of the two years' course the students are subjected to a written and a verbal examination, the former in agriculture, animal husbandry, and applied arithmetic, and the latter in agriculture and botany, animal husbandry, forestry and horticulture, chemistry and physics, applied arithmetic, and geometry. They are given standings in each study, and on passing the examination and properly completing the course receive diplomas from the agricultural school.

HIGHER EDUCATION, QUALIFICATIONS FOR ADMISSION, AND STUDIES.

The Royal Veterinary and Agricultural College at Copenhagen is the only institution of higher agricultural education in Denmark. This college has five separate departments, viz, veterinary, agricultural, land inspectoral, horticultural, and forestry. In addition, there are graduate courses for veterinarians and for graduates in the agricultural department proper, and also a school for farriers.

To be admitted to the college as a regular student the applicant must either have passed the examinations admitting him to the State University (bachelors of science or of arts) or must have passed the special entrance examinations prescribed, including examination in three foreign languages. Students in the veterinary department are also required to pass an examination in Latin. There is, furthermore, an opportunity to be admitted as a regular student by special permission of the department of the interior. Applicants must be at least 16 years of age, but the average age of the students is considerably higher than this, viz, over 20.

Special students are admitted without entrance examinations, and may receive diplomas on completion of the full course of study in any of the departments; they are, however, restricted from receiving any of the stipends or legacies of the college.

The courses of study offered in the different departments are comprehensive and thorough, being designed to give to the students a liberal technical education and to properly equip them for their profession.

The course in agriculture takes two to three years for completion and is divided into two divisions. In the first division lectures and recitations on the following subjects are given: Chemical physics, mechanics and optics, meteorology, inorganic and organic chemistry, analytical chemistry, geology and geognosy, soils, botany, biology, agricultural zoology, anatomy of farm animals, and agricultural machinery; laboratory and field work in chemistry, botany, biology, horticulture, and surveying and drafting. In the second division the subjects are as follows: Agricultural machinery (continued), plant culture, animal husbandry, dairying, farm bookkeeping, economics of agriculture, plant pathology; laboratory or field work, stock judging, and agricultural chemistry; compositions on agricultural topics.

The Danish Veterinary and Agricultural College offers exceptionally good facilities to students in the branches given; its equipment, buildings, laboratories, clinics, botanical garden, museums, and library are especially fine.

Aside from the lower and higher agricultural schools in the Scandinavian countries, a number of institutions give instruction in special branches as dairying, horticulture, forestry, and farriery.

Recommended for publication.

A. C. TRUE, *Director*.

Approved:

CHARLES W. DABNEY, Jr.,
Assistant Secretary.

WASHINGTON, D. C., *December 8, 1896.*

APPENDIX.

TECHNICAL HIGH SCHOOL, MUNICH, GERMANY.

Entrance requirements.	Three years' course in agriculture.							
	Year.	Science.	Agronomy.	Technology.	Zootechny.	Rural economy.	Drawing.	Bookkeeping.
The diploma of a gymnasium, realschule, or agricultural high school or academy.	First	Physics. Chemistry (general and organic). Mineralogy. Crystallography. Botany. Miscroscopy.* Zoology.*			Anatomy of domestic animals.		Mechanical.*	
	Second	Geology. Meteorology. Climatology. Fungi.* Vegetable pathology.* Microscopy.*	Soils. Plant nutrition. General agriculture. Meadows. Field demonstrations.*	Brewery. Sugar. Starch.	Animal physiology. Animal diseases.			
	Third	Bacteriology.* Microscopy.*	Special crops. Reclamation of land. Drainage. Field demonstrations.*	Dairying.	Nutrition of animals. Animal production (general and special). Hygiene.	Farm management. Rents and taxes.*		Agricultural bookkeeping.

* Optional.

AGRICULTURAL INSTITUTE, GEMBLOUX, BELGIUM.

Entrance requirements.				Three years' course of study.							
Language.	Mathematics.	Science.	History.	Science.	Agronomy.	Forestry.	Technology.	Zootechny.	Rural engineering.	Drawing and bookkeeping.	Economy and law.
French, orthography, grammar, composition, literary analysis (4 works from a given list of tragedies of Racine and Corneille, comedies of Racine and Molière, and orators).	Arithmetic (including square and cube roots and progressions). Algebra (including equations of first and second degree and the minima and maxima). Geometry (8 books of Legendre). Trigonometry (rectilinear).	Physics (general properties of matter, gravity, hydrostatics, pneumatics, and acoustics). Geography (political and physical, detailed for Belgium).	General history (outline). History of Belgium.	Physics. Meteorology. Chemistry (inorganic, organic, and analytical). Botany. Bacteriology. Zoology. Mineralogy (20 to 25 lessons). Geology (20 to 25 lessons). Microscopy.	First and second year, 105 lessons: Introductory (relation of sciences to agriculture; bibliography). Climate (heat and light in relation to plant production; atmospheric waters and electricity; climate as related to European agriculture). Soils (composition, physical and chemical properties, classification, clearing of land, drainage, irrigation, amelioration). Tillage (hand tillage, plowing, steam plowing, fallowing, harrowing, rolling). Manuring (general theory, farm manures, green manures, commercial fertilizers, lime, marl, etc.). Plant production (seeding, cuttings, tubers, etc.; times of seeding, quantities of seed, depth of planting, treatment of seeds, seeding tools). Culture, harvesting, preservation. Third year: Cereals, legumes, roots and tubers, oil plants, textiles, tobacco, hops, sugar cane, forage crops, meadows and pastures.	One lesson a week first year. Two lessons a week second year. Two lessons a week third year.	Sugarmaking. Brewery. Distillery. Dairying. Butter. Cheese. Limemaking. Fertilizer mixing and manufacture. Breadmaking.	Anatomy (15 lessons). Exterior of domestic animals (15 lessons). Physiology (38 lessons). Hygiene (25 lessons). Applied (60 lessons.) Breeds and breeding (horses, cattle, sheep, goats, pigs, fowls, fishes, silkworms, bees).	Algebra. Geometry. Trigonometry. Division of land. Surveying. Mechanics. Agricultural machines. Steam motors. Drainage. Hydraulics. Irrigation. Farm buildings.	Mechanical drawing. General bookkeeping. Agricultural bookkeeping.	Rural economy. Political economy. Rural law. Forestry law. Constitutional law.

NATIONAL SCHOOL OF AGRICULTURE, GRIGNON, FRANCE.

Entrance requirements.			Two and one-half years' course of study.							
Language.	Mathematics.	Science.	Science.	Agronomy.	Horticulture.	Forestry.	Technology.	Zootechny.	Rural engineering.	Rural economy.
French.	Arithmetic. Algebra. Geometry.	Physics. Chemistry. Geology. Botany. Zoology.	Botany. Chemistry (general and agricultural). Physics. Meteorology. Geology. Mineralogy. Physiology and hygiene of man.	Introduction (definition of scope of subject, relation to sciences, etc.). Soils (origin, classification, properties, relation to climate). Fertilizers (amendments, commercial fertilizers, farm manures, green manures). Drainage, irrigation, etc. Culture. Food plants (cereals, legumes). Forage plants. Meadows. Pastures. Root crops. Industrial plants (sugar, oil, textile, aromatic, etc.). Rotations.	General principles. Arboriculture. Vegetables. Viticulture.	General principles. Forest growing. Technology of wood. Forest management. Reforestation.	Sugar. Milling. Bread making. Starch. Dairying. Oils, etc. Brewery. Distillery. Textiles. Utilization of animal waste products. Fertilizers.	Anatomy. Physiology. Breeds and breeding (horses, cattle, sheep, goats, swine, etc.). Aviculture. Pisciculture. Hygiene. Police sanitation. Entomology.	Mechanics. Agricultural machines. Agricultural hydraulics (irrigation, drainage). Farm buildings.	Agricultural bookkeeping. Political economy. Rural economy. Rural law.
Diploma of practical school of agriculture, farm school, or other secondary school counts a number of points at entrance examination.										

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CIRCULAR NO. 32.—(Revised.) 190

United States Department of Agriculture,

OFFICE OF EXPERIMENT STATIONS.

REPORT OF COMMITTEE ON METHODS OF TEACHING AGRICULTURE.[1]

NEED OF UNIFORMITY IN THE STUDY OF AGRICULTURE.

The committee on methods of teaching agriculture submit a report of progress. From the outset of its work the committee has recognized the fact that a thorough investigation of the subject entrusted to it would require a long time. It has therefore endeavored during the past year simply to lay the foundation for future work. The first thing was to find out what was done in this country in the teaching of agriculture. A circular of inquiry sent out for the committee by the Office of Experiment Stations has elicited responses from about fifty colleges. These replies, grouped under thirteen general heads, have been tabulated and brief summaries have been prepared which will be submitted as a part of this report. A large amount of data has been collated in this way which will be useful in further studies in this line.

The general conclusion thus far drawn from an examination of the data, though a negative one, is well worthy of the serious consideration of the association. It is plainly shown that there exists at present in this country no standard for instruction in agriculture. There is a bewildering variety as regards the topics taught, the time devoted to each topic, the order in which the different topics occur in the course, the relative amount of class-room work and laboratory or practical exercises, etc. Granting all that ought to be conceded because of local conditions, it is nevertheless obvious that general progress in the teaching of agriculture in college courses can hardly be expected until there is greater uniformity in planning and conducting the course of study in this subject. Toward securing reasonable uniformity in this matter it behooves this association, as well as the individual teachers of agriculture, to give earnest heed.

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[1] This report, with accompanying papers, was presented to the Association of American Agricultural Colleges and Experiment Stations at the convention held in Washington, D. C., November 10–12, 1896.

The committee is not prepared at this time to go much beyond this simple declaration of the great need of studying this subject thoroughly and deeply. More time must be spent in digesting the data collected and in discussing the evidence adduced before detailed conclusions can be drawn. On one point, however, the committee wishes to present to the association some further considerations.

NECESSITY OF DEFINITE NOMENCLATURE.

One great obstacle to the intelligent discussion of the scheme of agricultural instruction and the methods of agricultural teaching is the lack of a definite nomenclature of the subject. This confusion of terms is evident in the data collected by the committee, as well as in much of the current discussion of this subject which appears in the public prints. It is obviously not an easy matter to bring order out of confusion in such a case. The committee has not been able to give time enough to this phase of the subject to definitely settle anything even in the minds of its own members. It proposes, however, to suggest for the consideration of the association a tentative scheme for the division of what is commonly designated agriculture in courses of study into several distinct branches or subdivisions, and for giving each of these branches a definite name, as follows:

Agriculture	1. Agronomy, or agriculture (technical).	Climate, soils, fertilizers, and crops—plant production.
	2. Zootechny, or animal industry.	Animal physiology and animal production.
	3. Agrotechny, or agricultural technology.	Agricultural industries, e. g., dairying, sugar making.
	4. Rural engineering, farm mechanics, or farm equipment.	Roads, drains, irrigation systems, farm buildings, etc.
	5. Rural economy, or farm management.	General policy of farm management, rural law, agricultural bookkeeping, etc.

If we can reach a point where the term *agriculture*, as applied to what is taught on agricultural subjects in a college course, shall generally be understood to include at its widest the five subordinate subjects indicated in the above scheme, and in its restricted sense only what applies to plant production, an important step will have been taken in settling the proper boundaries of agricultural instruction and in fixing the proper subdivisions of the general subject. It is probable that the substitution of a more definite and technical term for agriculture in its restricted sense would simplify matters. The term agronomy is tentatively suggested as such a term, and the opinion of members of the association on this, as well as on the other terms suggested, is invited.

COURSES IN AGRICULTURE IN FOREIGN SCHOOLS.

Before presenting the summary of data collected by the committee it may be well to add that examination of the courses in agriculture in foreign schools was made as far as practicable. One member of the committee had the privilege of visiting representative agricultural schools in Germany, France, Belgium, and Holland during the past summer, and holding personal conferences with leading agricultural educators in these countries. The general results of his observations will be given in a brief paper appended to this report. At the suggestion of the Director of the Office of Experiment Stations, Prof. F. W. Woll, of Wisconsin, made a special investigation of agricultural institutions in Denmark, Norway, and Sweden during a vacation trip last summer. A brief statement of the results of his observations is also appended to this report, and it is hoped that he will present a longer account in the Experiment Station Record.

J. B. CONNELL,
A. C. TRUE,
T. F. HUNT,
H. T. FRENCH,
H. H. WING,
Committee.

November 10, 1896.

SUMMARY OF DATA ON SOME POINTS IN CIRCULAR OF INQUIRY SENT BY COMMITTEE TO AGRICULTURAL COLLEGES.

SOILS AND SOIL PHYSICS.

This subject is taught under the following names: Soils, soils and crops, general agriculture, principles of agriculture, agricultural chemistry, etc. In 34 colleges the total time given to this subject varies from 10 to 280 and averages 70 hours; the time given to lectures or recitations varies from 8 to 75 and averages 37 hours; the time given to field or laboratory work varies from 0 to 269 hours.

Twelve colleges teach this subject in freshman year, 11 in sophomore year, 12 in junior year, and 5 in senior year. In 30 colleges this subject is taught by the professor of agriculture or his assistant, in 8 by the professor of chemistry, in 5 by the professor of physics, in 1 by the professor of biology.

FARM MANURES AND COMMERCIAL FERTILIZERS.

This subject is taught under the following names: Agriculture, agricultural chemistry, manures and fertilizers, soils and chemistry of plant growth, application of chemistry to agriculture, etc. In 30 colleges the time given to this subject varies from 5 to 228 minor or 418 major, and averages 61 hours; the time given to lectures or recitations varies from 5 to 85 and averages 40 hours; the time given to field or laboratory work varies from 4 to 190 hours.

Nine colleges teach this subject in freshman year, 10 in sophomore year, 11 in junior year, and 6 in senior year.

In 25 colleges this subject is taught by the professor of agriculture, or his assistant, in 9 by the professor of chemistry, in 1 by the professor of physics.

FARM CROPS.

This subject is taught under the following names: Agriculture, agricultural chemistry, farm crops, soils and crops, grasses and grains, grasses and forage plants, field crops, general farm management, etc.

In 28 colleges the time given to this subject varies from 10 to 315 and averages 81 hours; the time given to lectures or recitations varies from 8 to 200 and averages 39 hours; the time given to field or laboratory work varies from 0 to 250 hours.

Ten colleges teach this subject in freshman year, 10 in sophomore year, 11 in junior year, and 6 in senior year.

In 31 colleges this subject is taught by the professor of agriculture or his assistant, in 1 by the professor of chemistry, in 1 by the professor of physics, in 1 by the professor of biology.

BREEDS OF LIVE STOCK.

This subject is taught under the following names: Agriculture, breeds of live stock, apiculture, stock breeding, study of breeds, animal husbandry, stock judging, etc.

In 32 colleges the time given to this subject varies from 10 to 180 minor or 360 major and averages 76 hours; the time given to lectures or recitations varies from 6 to 90 and averages 39 hours; the time given to field or laboratory work varies from 0 to 90 hours minor or 270 major.

Eleven colleges teach this subject in freshman year, 8 in sophomore year, 16 in junior year, and 2 in senior year.

In 28 colleges this subject is taught by the professor of agriculture or his assistant, in 1 by the porfessor of biology, in 7 by the professor of animal husbandry.

ANIMAL EXTERIOR OR STOCK JUDGING.

This subject is taught under the following names: Agriculture, stock breeding, domestic animals, stock judging, animal husbandry, breeds and breeding, general agriculture, principles of breeding, animal mechanism and exterior, breeds of stock, etc.

In 15 colleges this subject is taught in connection with breeds of live stock, and in 1 with dairying; in 12 others the time given to it varies from 5 to 70 and averages 29 hours; the time given to lectures and recitations varies from 4 to 42 and averages 15 hours; the time given to field or laboratory work varies from 0 to 60 hours.

Three colleges teach this subject in freshman year, 3 in sophomore year, 7 in junior year, and 2 in senior year.

The professor of agriculture or his assistant gives instruction on this subject in each college reporting.

PRINCIPLES OF BREEDING.

This subject is taught under the following names: Agriculture, stock breeding, breeding farm animals, principles of heredity, breeding, feeding, dairying, animal husbandry, breeds and breeding, animal industry, etc.

In 30 colleges the time given to this subject varies from 8 to 210 and averages 51 hours; the time given to lectures or recitations varies from 8 to 70 and averages 34 hours; the time given to field or laboratory work varies from 0 to 140 hours.

In 1 college this subject is taught in freshman year, in 8 in sophomore year, in 13 in junior year, and in 10 in senior year.

In 25 colleges this subject is taught by the professor of agriculture or his assistant, in 5 by the professor of animal husbandry.

STOCK FEEDING.

This subject is taught under the following names: Agriculture, stock feeding, breeding, feeding, dairying, animal husbandry, breeds and breeding, agricultural chemistry, analyses of forage plants, principles of animal nutrition, chemistry of foods; feeding for butter, beef, and milk; foods and nutrition, feeds and feeding, etc.

In 32 colleges the time given to this subject varies from 15 to 185 minor or 370 major, and averages 84 hours; the time given to lectures or recitations varies from 12 to 80 and averages 40 hours; the time given to practical or laboratory work varies from 0 to 125 hours minor or 310 major.

In 2 colleges this subject is taught in freshman year, in 5 in sophomore year, in 14 in junior year, and in 15 in senior year.

In 29 colleges this subject is taught by the professor of agriculture or his assistant, in 3 by the professor of chemistry, in 4 by the professor of animal husbandry, in 1 by the professor of veterinary science.

BUTTER MAKING.

This subject is taught under the following names: Dairying, general and agricultural chemistry, home dairying, farm dairying, the dairy, butter making, dairy husbandry, etc.

In 27 colleges the time given to this subject varies from 6 to 784 and averages 104 hours; the time given to lectures or recitations varies from 6 to 110 hours; the time given to practical or laboratory work varies from 10 to 620 hours.

In 3 colleges this subject is taught in freshman year, in 7 in sophomore year, in 10 in junior year, and in 10 in senior year.

In 15 colleges this subject is taught by the professor of agriculture, or his assistant, in 4 by the professor of chemistry, in 2 by the professor of animal husbandry, in 10 by the professor of dairying, in 1 by the professor of household economy.

CHEESE MAKING.

This subject is taught under the following names: Cheese making, dairying, dairy husbandry, Cheddar cheese making, etc.

In 6 colleges the time given to this subject varies from 4 to 550 and averages 207 hours; the time given to lectures and recitations varies from 4 to 36 and averages 22 hours; the time given to laboratory or practical work varies from 0 to 300 hours.

Six colleges teach this subject in the junior year, 2 in the senior year.

In 2 colleges this subject is taught by the professor of chemistry, in 4 by the professor of dairying or his assistants, and in 2 by the professor of agriculture or his assistant.

FARM ENGINEERING OR EQUIPMENT.

This subject is taught under the following names: Agriculture, farm machinery, highways and pavements, engineering, farm equipment, agricultural engineering, irrigation engineering, farm mechanics, etc.

In 20 colleges the time given to this subject varies from 10 to 240 and averages 75 hours; the time given to lectures and recitations varies from 10 to 72 and averages 40 hours; the time given to practical or laboratory work varies from 10 to 72 hours.

Four colleges teach this subject in the freshman year, 7 in the sophomore year, 5 in the junior year, and 7 in the senior year.

In 17 colleges this subject is taught by the professor of agriculture or his assistant, in 1 by the professor of civil engineering, in 1 by the professor of animal industry, in 3 by the professor of mathematics, in 2 by the professor of physics.

RURAL ECONOMICS OR FARM MANAGEMENT.

This subject is taught under the following names: Agriculture, farm management, farm economy, political economy, farm accounts, rural economics, farm relations and management, etc.

In 11 colleges the time given to this subject varies from 10 to 140 and averages 49 hours; the time given to lectures varies from 10 to 140 and averages 38 hours; the time given to practical or laboratory work varies from 0 to 60 hours.

Two colleges teach this subject in the freshman year, 3 in the sophomore year, 5 in the junior year, and 5 in the senior year.

In 14 colleges this subject is taught by the professor of agriculture, in 1 by the professor of horticulture, in 1 by the professor of chemistry.

HISTORY OF AGRICULTURE.

In a number of the colleges this subject is not taught at all, and in others in connection with other subjects. It is taught under history of agriculture in 6 colleges, where the time given to it varies from 10 to 55 and averages 27 hours.

Two colleges teach this subject in the freshman year, 3 in the sophomore year, 1 in the junior year, and 2 in the senior year.

In 13 colleges this subject is taught by the professor of agriculture or his assistant, in 2 by the professor of chemistry.

MISCELLANEOUS.

The following subjects are by different colleges considered a part of the course in agriculture :

Viticulture,
Olive culture,
Pomology,
Horticulture,
Botany,
Bacteriology,
Plant breeding,
Plant diseases,
Forestry,
Entomology,
Veterinary science
Poultry keeping,
Handling meats,
Sugar making,
Sugar chemistry,
Sugar beets,
Meteorology,
Textile fibers,
Domestic economy,
Physical geography,
Principles of evolution.

SOME FEATURES OF EUROPEAN INSTITUTIONS FOR AGRICULTURAL EDUCATION.

By A. C. True, Ph. D.,

Director of the Office of Experiment Stations.

AGRICULTURAL EDUCATION IN EUROPE.

The system of agricultural education in Europe is much more complex than our own. It includes schools of different grades, ranging from those for quite elementary education in connection with the public school system up to those of university grade. If we undertake to consider schools of any particular grade in this series, we shall find that their organization and courses vary with the locality, so that it would be hardly fair to select any one institution as typical.

In a general way, however, we may classify European institutions for agricultural education as follows: (1) Department of universities; (2) institutes for higher education in agriculture, more or less closely affiliated with universities; (3) institutes organized as separate institutions; (4) schools of secondary grade under governmental control; (5) schools of secondary grade managed by private individuals or corporations (often religious orders) subsidized by the Government; (6) courses in agriculture of secondary grade in public or private schools for general education; (7) courses in agriculture in normal schools for the training of teachers in primary schools; (8) courses in agriculture in public or private primary schools; (9) evening schools giving elementary instructions in agriculture; (10) short courses of lectures on general agriculture or on special agricultural subjects; and, (11) farmers' meetings, corresponding to our farmers' institutes.

PROMINENCE OF POST-GRADUATE EDUCATION.

In the European scheme of agricultural education a relatively large place has been given to the higher or post-graduate education in agricultural science. Numerous opportunities are afforded for the most thorough and scientific training in the different branches of this complex science. The result is that there is an ever-increasing body of well-trained investigators and teachers whose services can be utilized at the experiment stations, agricultural schools, agricultural departments of the Governments, or in those agricultural industries requiring scientific knowledge of a high order. The value of such workers to agricultural research and education can hardly be overestimated. Until we are able to secure such thoroughness of training for our investigators and teachers we must expect a certain structural weakness to prevade our whole system of agricultural research and education. It is true that some of our workers in these lines get a part of their training in the foreign schools. This is far better than that they should not have it at all, yet some of us can not help but feel that along with much that is very good from every point of view they are apt to acquire a foreign trend of thought which ofttimes hinders their highest success in this country. And surely, we will not be content until the United States affords in agriculture, and every other branch of learning, at least as good opportunities for the highest education as can be found anywhere in the world.

SPECIAL COURSES IN EUROPEAN INSTITUTIONS.

Another element of the European plan of education in agriculture, as in other subjects, is what may be called freedom to obtain what the capabilities, inclinations, or necessities of the student require. In connection with institutions for superior or secondary education in agriculture, provision is made for special students who are relieved from entrance examinations and may either follow the general course or pursue selected topics as may be agreed upon with the managing body of the institution. This is in accordance with the general plan followed in Europe with respect to higher education. Thousands of students, who have no intention of taking a degree, are thus pursuing special courses in the universities and higher schools. This privilege is undoubtedly abused to a considerable extent, but is believed to raise the general level of intelligence in the community and secure for the higher schools a large number of influential constituents. It might well be doubted whether any such plan could be followed in American colleges and universities under present conditions. It is probable, however, that we have hitherto erred in insisting too rigidly on definite requirements for all or nearly all the students admitted to our higher institutions. The result of this plan has been that many institutions have felt obliged to keep the requirements for a degree at too low a grade, and they have probably excluded altogether a considerable number of students who might have profited more or less by their instruction. There is, of course, in this country a great lack of good secondary schools, and our colleges are therefore required to give their students routine instruction with a view to fixing their habits of study. In this way in many of our institutions two years are mainly occupied in work which would properly be done in secondary schools. This makes it necessary for the college to be more rigid in its courses of study and to have codes of regulations which must apply to all students alike without due reference to their age and acquirements or the purpose for which they come to the college. It is to be hoped that in the near future many of our colleges will be able to raise the standard of their courses leading to degrees without at the same time depriving students who desire to pursue special courses of the privileges which they might properly enjoy in these institutions.

ELEMENTARY INSTRUCTION IN FRANCE AND BELGIUM.

As regards elementary instruction in agriculture to children in the ordinary schools, France and Belgium are the countries which have undertaken this kind of work on the most systematic plan. The following example may serve to illustrate the character of this work under quite favorable conditions:

During the past summer the writer visited a primary school in Belgium which is fortunate in possessing a well-equipped teacher, thoroughly interested in agricultural instruction. This school is located at a small village in one of the most populous districts of Belgium. At the time of the visit the teacher gave a lesson on the properties and uses of milk to a class of boys and girls about 12 years old. Samples of milk and cream were brought into the presence of the pupils, together with other illustrative material relating to the composition and uses of milk. By means of elementary chemical experiments and skillful questioning, the teacher gave to the pupils a simple but clear explanation of such matters relating to the composition and uses of milk as they could reasonably be expected to understand at that early age. The summing up of the lesson by different members of the class showed that they had been well taught, and there is no doubt that from that time forth the horizon of their knowledge regarding milk was considerably wider than if the lesson had not been given. The teacher of this class was a man, as it is not customary to employ women in the public schools in Belgium. He had evidently made good use of the very limited means at his disposal for providing illustrative material for his classes. The walls of the schoolroom were hung with charts, on many of which were pictures of agricultural implements, different varieties of plants, etc., which had been cut from advertising posters. Adjoining the school was a small garden, in which a considerable number of different kinds of plants were grown and different methods of culture were tried for the information of the pupils. Close by were the rooms of the agricultural society of the village, which contained collections of seeds, grains, etc., as well as charts giving the composition of fertilizers, results of experiments, and other things which would be of interest in connection with the discussions of the society, and which were doubtless available for use in the school. The teacher of the school acted as secretary of the society, aiding the farmers in the purchase of fertilizers and in other ways. Rooms were being fitted up for a cooperative dairy for the benefit of the villagers, which was to be supplied with the most improved appliances for the creamery business. It seems quite clear that children trained in a school under such circumstances would have a much broader outlook regarding agricultural affairs and be much more inclined to avail themselves of the results of advanced experience and experimentation in agriculture than their fathers had been.

It must be said, however, that this work is still regarded as in an experimental stage. The chief things lacking to make it thoroughly successful are good teachers and suitable text-books. In Germany this lack has been largely instrumental in preventing the undertaking of systematic instruction in these schools. There have been some attempts in this direction, but they have been voluntary on the part of the teachers. Recently a beginning has been made in Germany of providing instruction in agriculture in the normal schools. Such teaching in the normal schools of France and Belgium is pursued with more system and the number of teachers who are equipped to give elementary instruction in agriculture is increasing. In Germany elementary instruction in agriculture for adults is provided by what are called "winter schools," which are held for five or six months during the period from October to May. These are said to be quite successful and are increasing in number. During the summer season the teachers of these winter schools are occupied in lecturing and other work for the agricultural societies. Short courses of lectures in general agriculture or on special agricultural subjects, and farmers' meetings of one or two days' duration, corresponding somewhat to our farmers' institutes, are provided in several countries and are quite largely relied upon for disseminating the results of investigations in agriculture at the experiment stations and kindred institutions. To a considerable extent these take the place of the experiment station bulletins.. There is a strong feeling in Europe that in order to make agricultural science of use to the ordinary farmer there must be oral teaching and ocular demonstrations by means of simple experiments or field tests.

SECONDARY SCHOOLS.

The secondary schools in agriculture range from very practical schools, in which a large amount of work is required of the students, to institutions in which the instruction is altogether theoretical and constitutes but a small part of the general curriculum. In the best schools of this grade the tendency is to reduce the amount of practical work required of the students and to treat the farm and garden more and more as an agricultural or horticultural laboratory. These schools are well provided with apparatus, collections of specimens, and other material for illustration and demonstration. The teachers are as a rule men who have received a thorough general and scientific education, and their pedagogic ability and experience are also taken largely into account in filling vacant positions. The method of intuitive or object teaching has been more thoroughly elaborated in Europe than in this country. As a rule, therefore, without doubt, the quality of the teaching done in these schools is relatively high. The practical end to be attained is kept clearly in view in the courses of instruction in these secondary schools. It is expected that their graduates will go into some kind of agricultural industry. They are very likely to become managers of estates or horticultural establishments. The course in agriculture in these schools actually occupies two or three years. In such schools in Germany a six years' course is provided, three years of which are given to general education. The first three years, however, are for those who have not had opportunities for instruction in the gymnasium or realschule. Students who have had proper preliminary training are permitted to take the agricultural course only. As regards the teachers in these schools, the same difficulty is met with that often presents itself in secondary schools in this country. The teachers being thoroughly educated men and interested in scientific work and problems, are likely to raise the grade of their instruction until they entirely shoot over the heads of their students. It requires the services of superintendents and other officers to keep the instruction at its proper level.

INSTITUTIONS FOR HIGHER EDUCATION.

The institutions for higher education in agriculture are, generally speaking, of the university grade, whether organized as departments of universities or as independent agricultural institutes or schools. The presumption is that the student coming to these institutions has finished his secondary education and is prepared to devote himself in a somewhat independent way to advanced work along the special lines of agricultural science. If he is seeking for a degree he will pursue some approved course of study on the university plan for two or three years, at the end of which he will present a thesis and submit to severe examination. For a degree in agriculture he must, as a rule, prove that he is acquainted with the practical operations of the farm. This knowledge he must obtain for himself, however, either by experience in his earlier life or by practice during vacations or at some other time before coming up for his final examinations. In other words, the acquirement of practical knowledge of agriculture is not considered a part of the course of study. The tendency in these higher institutions is more and more toward abstract and scientific education. The effort is to give a man thorough scientific training by the most approved modern methods and to make him an independent worker in agricultural science in the hope that in future he may be able to advance knowledge in this direction by his own efforts. At the same time numerous students are admitted to the lectures and laboratory courses for the purpose of gaining special information which they deem useful to them for any purpose. Only general tests are required of them for admission, and their proficiency in their chosen studies is not examined into. As long as they do not interfere with the work which is going on for the benefit of students seeking degrees, little attention is given to what they do. In conversations this summer with leaders of agricultural education abroad, it was interesting to observe that they laid great stress on the thorough scientific training of the men who are to be future teachers and investigators in agricultural science. They said that their courses for higher education in agriculture were planned with reference to giving training rather than imparting information. It was not so important that the students should learn certain definite things as that they should acquire scientific methods of thought and activity. As regards preparation for university courses in agriculture, there is still division of opinion in Germany as to whether it is better for the student to take his preliminary studies in the gymnasium or in the realschule. (The gymnasium is a classical school, taking boys at 9 or 10 years of age and giving them a nine years' course, largely in Latin, Greek, and mathematics. The realschule substitutes instruction in natural science for the classics.) The older men who now stand at the head of agricultural science and education are inclined to the opinion that the students who have been trained in the gymnasium are the most thoroughly prepared to understand and appreciate the scientific courses given in universities even in lines relating to agriculture. The younger men, however, many of whom have themselves been educated in the realschule, are in favor of these schools. It is argued on behalf of the gymnasium that, while it gives very little attention to the natural sciences, its courses of study in the languages and mathematics have been thoroughly organized on truly scientific principles of pedagogy, and that the teachers in the gymnasium are as a rule more thoroughly equipped for their work. The students coming from these schools have greater intellectual acumen and have learned more thoroughly how to study. While it is true that their powers of observation as regards the outside world have not been exercised as much as they might be, on the whole they have had such a course of mental gymnastics as fits them easily to take up serious work in any line. It is undoubtedly true that much still remains to be done in Europe as well as in this country in systematizing education in natural sciences and technical subjects and reducing it to pedagogical form. As regards agriculture, there is great variety of opinion as to what subjects should be taught, the topics which should be especially considered in a given period, and the ways in which the different portions of the course should be related to each other. Thus far, especially in the higher institutions for agricultural education, it would appear that efforts have been directed mainly toward specialization of work. This may readily be seen by examining the programmes of such institutions. For example, the Royal Agricultural High School or Institute in Berlin has separate instructors in the following subjects: Physics and meteorology, chemistry, vegetable physiology, mineralogy, geology and soils, geodesy, animal production, zoology, plant production, mathematics, political economy, rural economy, agricultural systematic botany, animal physiology, wine making, veterinary science, agricultural engineering, beet-sugar making, farriery, fruit and vegetable culture, animal anatomy, culture technic, entomology, agricultural machines, colonization and tropical agriculture, chemistry of nutrition. What is to be taught under each of these subjects is largely left to the individual instructor. Laboratory work and the use of collections and other illustrative material, including field and garden demonstrations of agricultural subjects, are more and more employed. Eminent teachers and general officers agree that more attention should be given to the consideration of what is properly included in regular courses in technical agriculture. The following off-hand scheme for a four years' course in agriculture was sketched for the writer by one of the most eminent teachers of Europe. The course simply represents his thought on the matter at the time when it was made. According to the European fashion it was divided into semesters or half-year periods.

First year, first and second semesters: Natural sciences on which agricultural science is based, chemistry, botany, and physics.

Second year, first semester: Chemistry, laboratory practicums, agricultural chemistry, and anatomy.

Second year, second semester: Agricultural chemistry and veterinary science.

Third year, first semester: General agriculture, culture of plants, animal production, and diseases of plants.

Third year, second semester: Dairying, special agriculture, special plant culture, and foods and feeding.

Fourth year, first semester: Arboriculture and work in agricultural laboratory.

Fourth year, second semester: Review.

While this course should not be taken as an order of studies carefully worked out, it represents very well a fundamental idea much insisted upon by the leaders in agricultural education in Europe, namely, that a sound basis of general scientific training should be laid before the science of agriculture can be pursued with advantage. You will observe that the first half of the tentative four years' course just outlined is occupied with laying the foundation for the course in technical agriculture. When this foundation is well laid, then quite rapid progress can be made with the instruction in the science of agriculture per se—that complex science which of necessity takes the facts and principles of several other sciences and recombines them into a science which has direct relations with the practical art of agriculture. In many European schools of agriculture it is expected that the scientific basis will be laid before entrance.

LACK OF SYSTEM IN COLLEGES OF AGRICULTURE IN THE UNITED STATES.

It is, perhaps, at this point that our colleges of agriculture have the greatest difficulty. They are at present such mixed schools. They are attempting to inculcate the practical and add to it a little of the scientific. Or if they have a higher aim, they deem it advisable for prudential or other reasons to extend the course in agriculture through the entire four years' curriculum. As our secondary schools as a rule give very little serious attention to the sciences on which agricultural science is based, either the college students in agriculture are led into scientific mazes which they can not follow, or else the time of the professor of agriculture is taken up in the somewhat futile attempt to explain the scientific basis of agricultural problems to students who have little or no conception of the elementary principles of science. If we add to this the expenditure of considerable time of the students in practical exercises, the result is likely to be that the graduate from even a four years' course in agriculture has a badly assorted stock of knowledge of agricultural science and lacks that thorough and systematic grasp of the subject which is necessary to enable him to fully appreciate its significance or to work successfully as an investigator in advancing the science. Granting all that may be said regarding the differences between European conditions in education and our own, is it not likely that we will be obliged to consider more carefully some of those fundamental questions before we can expect much real advancement in thorough agricultural instruction? Our friends across the water will, without doubt, gladly join with us in efforts to elaborate the pedagogical details of agricultural education. They readily confess that they have hitherto not given the attention to this matter which the subject deserves. But they will be loth to acknowledge that there can be any other proper basis for thorough training in the science of agriculture than a systematic training in the principles of the sciences underlying agriculture.

NOTES ON AGRICULTURAL EDUCATION IN THE SCANDINAVIAN COUNTRIES.

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SYSTEM OF EDUCATION.

The system of agricultural education in the Scandinavian countries is arranged along two distinctive lines, secondary and higher instruction. The schools providing elementary instruction in agriculture are located in different parts of each country, and are supported partly by the district in which they are located, and partly by the state; in some cases the state contributes one-half or three-fourths to the support of the schools; in other cases less. There are 12 schools of this kind in Norway, 11 in Denmark, 37 in Sweden, and 12 in Finland; in the last country 11 lower agricultural schools more are provided for and will begin operations in the near future.

In this brief sketch it will only be possible to touch upon the more prominent features of the instruction offered in the institutions of the two kinds mentioned. Since there are but few differences, and these of minor importance, between the systems adopted in the different Scandinavian countries and Finland, it may be sufficient here to describe the plan followed in one country.

SECONDARY SCHOOLS, QUALIFICATIONS FOR ADMISSION, STUDIES, ETC.

The secondary agricultural schools of Norway are built upon common-school education, the aim being to impart fundamental knowledge in agricultural branches for future farmers. The course of instruction generally lasts two years, but occasionally one and one-half years. The system of instruction is partly theoretical, partly practical. The theoretical instruction is given during the winter semester only, viz, from October to April, and the practical instruction during the summer months. The different schools only admit a limited number of pupils in each course, generally twenty-four each, the number decided upon in each case being selected from the list of applicants according to their qualifications.

To be admitted, students must be 18 years of age on entering the school; of late years the average age of applicants has been nearly 20 years. Each must produce a certificate from a doctor that he is strong, without bodily defects, and free from contagious disease; also from his pastor that he has lived an irreproachable life. He must be able to write fairly correct from dictations, must be efficient in plain arithmetic, and have a fair knowledge of geography and the history of his country; he must finally have had practice in ordinary farm work, and must send in his own application to the director of the school. In filling places at the schools, preference is given to applicants living in the district which in part supports the school, and to oldest sons owning allodial rights, who therefore may be expected to settle as farmers in the district.

The theoretical instruction, which generally occupies three hours a day during the winter semester, covers the following preparatory studies: Composition, applied arithmetic, plain geometry, chemistry, and physics. The following basal studies are taught: Agriculture (including dairying), forestry, horticulture, bookkeeping and accounts. Practical exercises are furthermore given in surveying, farm machinery, map and building design, drainage, forestry, horticulture, blacksmithing, and carpentry work. These latter studies are taught throughout the year, as far as circumstances permit; in the summer months instruction is largely confined to work in the field or the barns, the students taking part in the regular farm work under the direction of the farm superintendent or the teacher of agriculture. The farms at which the schools are held generally belong to the district (county) where they are located, and vary in size from 100 acres to 200 acres, or more. They are well equipped, and stocked with improved farm animals; there is always a dairy herd at the farms, often numbering 50 head of cattle or more.

At the conclusion of the two-years' course the students are subjected to a written and a verbal examination, the former in agriculture, animal husbandry, and applied arithmetic, and the latter in agriculture and botany, animal husbandry, forestry and horticulture, chemistry and physics, applied arithmetic, and geometry. They are given standings in each study, and on passing the examination and properly completing the course receive diplomas from the agricultural school.

HIGHER EDUCATION, QUALIFICATIONS FOR ADMISSION, AND STUDIES.

The Royal Veterinary and Agricultural College at Copenhagen is the only institution of higher agricultural education in Denmark. This college has five separate departments, viz, veterinary, agricultural, land inspectoral, horticultural, and forestry. In addition, there are graduate courses for veterinarians and for graduates in the agricultural department proper, and also a school for farriers.

To be admitted to the college as a regular student the applicant must either have passed the examinations admitting him to the State University (bachelors of science or of arts) or must have passed the special entrance examinations prescribed, including examination in three foreign languages. Students in the veterinary department are also required to pass an examination in Latin. There is, furthermore, an opportunity to be admitted as a regular student by special permission of the department of the interior. Applicants must be at least 16 years of age, but the average age of the students is considerably higher than this, viz, over 20.

Special students are admitted without entrance examinations, and may receive diplomas on completion of the full course of study in any of the departments; they are, however, restricted from receiving any of the stipends or legacies of the college.

The courses of study offered in the different departments are comprehensive and thorough, being designed to give to the students a liberal technical education and to properly equip them for their profession.

The course in agriculture takes two to three years for completion and is divided into two divisions. In the first division lectures and recitations on the following subjects are given: Chemical physics, mechanics and optics, meteorology, inorganic and organic chemistry, analytical chemistry, geology and geognosy, soils, botany, biology, agricultural zoology, anatomy of farm animals, and agricultural machinery; laboratory and field work in chemistry, botany, biology, horticulture, and surveying and drafting. In the second division the subjects are as follows: Agricultural machinery (continued), plant culture, animal husbandry, dairying, farm bookkeeping, economics of agriculture, plant pathology ; laboratory or field work, stock judging, and agricultural chemistry; compositions on agricultural topics.

The Danish Veterinary and Agricultural College offers exceptionally good facilities to students in the branches given; its equipment, buildings, laboratories, clinics, botanical gardens, museums, and library are especially fine.

Aside from the lower and higher agricultural schools in the Scandinavian countries, a number of institutions give instruction in special branches, as dairying, horticulture, forestry, and farriery.

Recommended for publication.

A. C. TRUE,
Director.

Approved :
JAMES WILSON,
Secretary.

WASHINGTON, D. C., *November 15, 1897.*

APPENDIX.

TECHNICAL HIGH SCHOOL, MUNICH, GERMANY.

Entrance requirements.	Three years' course in agriculture.							
	Year.	Science.	Agronomy.	Technology.	Zootechny.	Rural economy.	Drawing.	Bookkeeping.
The diploma of a gymnasium, realschule, or agricultural high school or academy.	First	Physics. Chemistry (general and organic). Mineralogy. Crystallography. Botany. Microscopy.* Zoology.*			Anatomy of domestic animals.		Mechanical.*	
	Second	Geology. Meteorology. Climatology. Fungi.* Vegetable pathology.* Microscopy.*	Soils. Plant nutrition. General agriculture. Meadows. Field demonstrations.*	Brewery. Sugar. Starch.	Animal physiology. Animal diseases.			
	Third	Bacteriology.* Microscopy.*	Special crops. Reclamation of land. Drainage. Field demonstrations.*	Dairying.	Nutrition of animals. Animal production (general and special). Hygiene.	Farm management. Rents and taxes.*		Agricultural bookkeeping.

*Optional.

AGRICULTURAL INSTITUTE, GEMBLOUX, BELGIUM.

Entrance requirements.				Three years' course of study.							
Language.	Mathematics.	Science.	History.	Science.	Agronomy.	Forestry.	Technology.	Zootechny.	Rural engineering.	Drawing and bookkeeping.	Economy and law.
French orthography, grammar, composition, literary analysis (4 works from a given list of tragedies of Racine and Corneille, comedies of Racine and Moliere, and orators).	Arithmetic (including square and cube roots and progressions). Algebra (including equations of first and second degree and the minima and maxima). Geometry (8 books of Legendre). Trigonometry (rectilinear).	Physics (general properties of matter, gravity, hydrostatics, pneumatics, and acoustics). Geography (political and physical, detailed for Belgium).	General history (outline). History of Belgium.	Physics. Meteorology. Chemistry (inorganic, organic, and analytical). Botany. Bacteriology. Zoology. Mineralogy (20 to 25 lessons). Geology (20 to 25 lessons). Microscopy.	First and second year, 105 lessons: Introductory (relation of sciences to agriculture; bibliography). Climate (heat and light in relation to plant production; atmospheric waters and electricity; climate as related to European agriculture). Soils (composition, physical and chemical properties, classification, clearing of land, drainage, irrigation, amelioration). Tillage (hand tillage, plowing, steam plowing, fallowing, harrowing, rolling). Manuring (general theory, farm manures, green manures, commercial fertilizers, lime, marl, etc.). Plant production (seeding, cuttings, tubers, etc.; times of seeding, quantities of seed, depth of planting, treatment of seeds, seeding tools). Culture, harvesting, preservation). Third year: Cereals, legumes, roots and tubers, oil plants, textiles, tobacco, hops, sugar cane, forage crops, meadows, and pastures.	One lesson a week first year. Two lessons a week second year. Two lessons a week third year.	Sugar making. Brewery. Distillery. Dairying. Butter. Cheese. Limemaking. Fertilizer mixing and manufacture. Bread making.	Anatomy (15 lessons). Exterior of domestic animals (15 lessons). Physiology (38 lessons). Hygiene (25 lessons). Applied (60 lessons). Breeds and breeding (horses, cattle, sheep, goats, pigs, fowls, fishes, silkworms, bees).	Algebra. Geometry. Trigonometry. Division of land. Surveying. Mechanics. Agricultural machines. Steam motors. Drainage. Hydraulics. Irrigation. Farm buildings.	Mechanical drawing. General bookkeeping. Agricultural bookkeeping.	Rural economy. Political economy. Rural law. Forestry law. Constitutional law.

NATIONAL SCHOOL OF AGRICULTURE, GRIGNON, FRANCE.

Entrance requirements.			Two and one-half years' course of study.							
Language.	Mathematics.	Science.	Science.	Agronomy.	Horticulture.	Forestry.	Technology.	Zootechny.	Rural engineering.	Rural economy.
French.	Arithmetic. Algebra. Geometry.	Physics. Chemistry. Geology. Botany. Zoology.	Botany. Chemistry (general and agricultural). Physics. Meteorology. Geology. Mineralogy. Physiology and hygiene of man.	Introduction (definition of scope of subject, relation to sciences, etc.). Soils (origin, classification, properties, relation to climate). Fertilizers (amendments, commercial fertilizers, farm manures, green manures). Drainage, irrigation, etc. Culture. Food plants (cereals, legumes). Forage plants. Meadows. Pastures. Root crops. Industrial plants (sugar, oil, textile, aromatic, etc.). Rotations.	General principles. Arboriculture. Vegetables. Viticulture.	General principles. Forest growing. Technology of wood. Forest management. Reforestation.	Sugar. Milling. Bread making. Starch. Dairying. Oils, etc. Brewery. Distillery. Textiles. Utilization of animal waste products. Fertilizers.	Anatomy. Physiology. Breeds and breeding (horses cattle, sheep, goats, swine, etc.) Aviculture. Pisciculture. Hygiene. Police sanitation. Entomology.	Mechanics. Agricultural machines. Agricultural hydraulics (irrigation, drainage). Farm buildings.	Agricultural bookkeeping. Political economy. Rural economy. Rural law.
Diploma of practical school of agriculture, farm school, or other secondary school counts a number of points at entrance examination.										